alberta coal mining waste water effluent guidelines

Alberta

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ALBERTA COAL MINING
WASTE WATER EFFLUENT
GUIDELINES

January, 1978 (Reprinted, February, 1984)

The guidelines presented herein were developed by Alberta Environment and reviewed jointly by Alberta Environment and The Coal Association of Canada. They apply to all new coal mines that become operational after January 1, 1977 whether the operation entails a completely new mine site, an additional mine, or a major coal processing plant expansion on an existing mine site. Permits to Construct or Licences to Operate under the Clean Water Act will be issued provided that the provisions of these guidelines have been considered and adequate waste water management provided to comply with the standards. The extent of compliance required of existing coal mines will be determined on an individual basis depending on circumstances and will be specified in relevant licences or permits.

In accordance with Part 1, Section 6 of the Clean Water (General) Regulations being Alberta Statute 216/73, Alberta Environment hereby issues

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WASTE WATER EFFLUENT

GUIDELINES

Prepared By

Water Quality Branch

Standards & Approvals Division

Environmental Protection Services

January, 1978 (Reprinted, February, 1984)

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1. INTRODUCTION

1.1 General

The coal mining industry in Alberta has experienced a resurgence with a particular emphasis on surface mining operations. The coal mining industry requires water for coal cleaning in coal processing plants, for hydraulic mining, and for miscellaneous uses such as dust control and fire fighting. Water handling is essential to most coal mines, even if hydraulic mining and coal processing are not part of the operation, to ensure continuance of the operation and to ensure efficiency. Water enters mines via precipitation, groundwater seepage, and surface runoff. This water, which can become polluted by contact with materials in the coal, overburden material, and foot wall, is discharged from the mine as waste water and may require treatment before discharge into a receiving waterway.

1.2 Objectives

These guidelines are intended to describe waste water controls and emission standards for coal mining operations with a view to achieving the following objectives:

(a) reduce the levels of contaminants in mine waste water;
(b) reduce the volume of discharge where practicable;
(c) guide coal mine operators as to the relevance of the Clean Water Act.

1.3 Definitions

For the purposes of these guidelines the following terms are defined to ensure clarity:

"coal processing plant" means any installation for upgrading the quality of coal or for producing a marketable solid fuel; and includes any coal storage facility directly associated with it;

"mine" means any working, other than a drill hole made while exploring for coal, from which coal is or could be extracted, whether commercially or otherwise;

"mine site" means a location at which a facility for extracting coal by underground, strip, or open pit operations exists or is to be developed; and includes

(a) any coal processing plant or storage facility which exists or is to be developed in connection with the mine, and

(b) all connected access roads;

"open pit mine" means a mine worked by the removal of overlying strata and subsequent excavation of exposed coal in terrain that is not flat or substantially flat;

"operator" (a) a holder of a permit, licence, approval, permission, or consent pursuant to the Coal Conservation Act authorizing

(i) the development of a mine site, or

(ii) the operation of a mine or a coal processing plant, or

(iii) the suspension of operations at, or abandonment of, a mine or a coal processing plant;

(b) any person who undertakes to perform an operation pursuant to the scheme by agreement with a person referred to in subclause (a).

"strip mine" means a mine worked by the removal of overlying strata and subsequent excavation of exposed coal in flat or substantially flat terrain;

"underground mine" means any mine other than a strip mine or open pit mine;

"waste water" means any water drained, pumped, or siphoned from a coal mine, coal processing plant, or ancillary service facility on the mine site, excluding diverted surface water. In this definition, any water draining from unreclaimed haul roads, dumps, and coal piles is considered to be a waste water.

Note: Coal mine waste water standards apply only at points of discharge as specified in Section 4.2.

1.4 Issuance of Permits and Licences

Pursuant to Sections 3(1) and 4(1) of the Clean Water Act, a permit is required before commencing the construction of, and a licence before commencing operation of the following facilities:

(a) coal processing plant

(b) waste water treatment facility
(eg. retention pond, sewage treatment unit)

Applications shall be made to the Director of Standards and Approvals, Alberta Environment, in accordance with the Clean Water (Industrial Plants) Regulations OC 217/73. It should be noted that these facilities normally also require approval in terms of the Water Resources Act.

With the exception of the facilities specified above, the adequacy of waste water control facilities for new mines will be evaluated by the Division of Standards and Approvals of Alberta Environment using submissions to the Development and Reclamation Review (D & R) Committee or the Energy Resources Conservation Board pursuant to Section 21(1) and (2) of the Coal Conservation Act. If it is judged by the Division of Standards and Approvals that there are water quality concerns as a result of a mine and that inadequate waste water handling facilities are proposed, the operator will be required to make application to the Director of Standards and Approvals for a permit to construct adequate waste water treatment facilities pursuant to the Clean Water Act.

Licences to operate coal processing plants and waste water treatment facilities will be issued, were possible, as one document to cover waste water discharges for an entire mine site. Waste water discharges for a new mine on an existing mine site will be handled by a licence amendment and, if no new waste water treatment facilities are required, will be based on the application to the Energy Resources Conservation Board for a mining licence or any pertinent information submitted to the Development and Reclamation Review Committee.

Proposed minor modifications to mine waste water facilities or retention ponds that are covered by a licence under the Clean Water Act shall be referred to the local Land Surface Conservation and Reclamation Council Member in the field. This individual may either authorize the modification on-site or instruct the operator to apply to the Director of Standards and Approvals for a permit and licence amendment, if the modification is more complex. Following construction of any modification, copies of the pertinent plans shall be supplied to the Council Member for dissemination to concerned agencies of the government.

Where an operator believes that certain conditions in the guidelines are impractical or irrelevant due to particular site-specific circumstances, the operator may request an exemption from those conditions in the course of applying for a permit or licence. Adequate justification must however be supplied to support any exemption application.

2. WASTE WATER MANAGEMENT

2.1 General

For the purposes of these guidelines, mine sites are considered to include two separate operations - coal mines and coal processing plants. Common to both these operations are ancillary services such as maintenance shops, offices, change houses, etc. which will be considered separately.

The types of coal recoverable in Alberta vary in rank from lignite to semi-anthracite. It is acknowledged that numerical standards regulating waste water quality from a coal mine operation should recognize differences in mine type, location, and particularly the nature of the coal-bearing strata and overburden. In order to minimize complexity, this factor has been taken into account by allowing for natural background surface water quality composition.

Alberta is fortunate in that the sulphur content of its coal deposits is generally low, with some minor exceptions. Sulphur content is usually less than 1.0% in the southwestern quarter of the Province and less than 0.5% elsewhere. Acidic mine drainage is, consequently, most unlikely; therefore this condition has not been addressed in these guidelines. Should this problem arise on a specific site, waste water standards will be set on an individual basis.

2.2. Coal Processing Plant Waste Water

The following guidelines apply to all coal processing plants as well as hydraulic mine coal transport water:

(a) The plant and any tailings ponds shall be operated on a closed water circuit. There shall be no discharge of process waste water and plant site surface runoff to natural drainage except as a result of minor natural seepage or the conditions specified in (c) and (d).

Note: Where topography and mine site layout considerations dictate that it would be optimum to use integrated facilities for treating plant site runoff and mine waste water, the discharge of the combined waste waters in excess of what can be practically used as plant process water shall be permissible. The standards in Section 4, Schedule A shall apply to the discharged waste waters.

(b) The discharge of tailings solids to any tailings pond shall be minimized by the installation and operation of the best practicable secondary solids removal equipment currently available.

(c) The overflow of waste water from a tailings pond shall be permissible when a 20-year (24-hour duration) storm is exceeded on the mine site.

(d) Plant site retention ponds (including the thickener dump pond), storm sewers, diversion ditches, pumps, or any other surface runoff water handling facility shall be designed to accommodate at least a 10 year storm. The overflow of the plant site surface runoff control facilities shall be permissible only when a 10 year storm is exceeded on the mine site.

(e) The plant siting shall meet the requirements of the Land Surface Conservation Act with particular reference to the Land Conservation Guideline Schedule in Regulation 125/74.

2.3. Coal Mine Waste Water

Due to the land disturbance inherent in strip mining and open pit mining, the control of water within the mining area requires careful preplanning and often correspondingly extensive controls. Usually in this case, the siltation of streams and lakes is the major concern. On the other hand, underground mining generally causes little ground disturbance and concerns could include the transport of coal fines in runoff from coal piles or in water pumped from the mine tunnels and, in some cases, the discharge of high iron content groundwater into surface waters.

The following guidelines apply to all mines whether they are open pit mines, strip mines, or underground mines:

(a) All mine waste waters except hydraulic mine coal transport waters shall be subject to the mine waste water standards in Section 4, Schedule A.

(b) All surface disturbance activities shall meet the requirements of the Land Surface Conservation and Reclamation Act and associated Regulations.

(c) Unless it can be assured that the mine waste waters will meet the mine waste waters standards in Section 4, Schedule A, the operator shall make application to construct adequate waste water control and treatment facilities as described in Section 1.4.

(d) All drainage ditches, storm sewers, or other waste water control facilities shall be designed for at least a 10-year storm, or for larger flows if required in terms of the Water Resources Act.

(e) All retention ponds shall be designed according to the guidelines in Section 3.

(f) Soil stockpiles shall be located such that they will not be a source of sediment to watercourses, and where necessary, stockpiles shall be stabilized and ditched to prevent migration of material.

Preparation Plant

Tailings Pond

(g) Fine solids shall be disposed of in an area not subject to erosion. In particular, retention pond dredgings shall be discarded only in a location approved by the Land Conservation Council Member.

(h) All waste water control structures and retention ponds shall be constructed before preceeding with the clearing and excavation of the mining area which they are designed to serve.

(i) Where it is anticipated that an appreciable amount of groundwater will collect in an open pit or strip mine, the use of peripheral wells to reduce the local watertable should be considered. Water from these wells can usually be discharged untreated. Care must be taken to ensure that the discharge of well water does not cause excessive erosion to a slope or drainway.

(j) Where the waste water discharged from a mine is subject to significant oil and grease contamination, adequate pretreatment shall be provided to remove these contaminants before disposal.

(k) Where the waste water discharged from a mine contains iron levels in excess of the mine waste water standards in Section 4, Schedule A, or significant heavy metal levels, pretreatment shall be provided to achieve the maximum practicable removal of these contaminants, before dilution with other waste waters.

(l) The probable interaction of the mining operation with the local groundwater regime shall be established before the commencement of operations. (This impact should normally be addressed in an Environmental Impact Assessment.)

2.4 Ancillary Services Waste Water

2.4.1 Vehicle and General Maintenance Shop Waste Water

Waste water from these areas will include any washings and also surface runoff from the immediate area. The waste water shall all be collected in drains or channels and treated to remove any oil and silt from discharge. Oil traps or tilted

Open pit mine in mountain region

Small settling pond

plate separators combined with retention ponds could be used for this purpose. Depending on the flow and contaminants, disposal of part of the waste water via nearby above-ground sewage treatment facilities may be feasible. No specific waste water standards for oil and grease are included in Section 4, Schedule A. These will be considered on a site specific basis in licences pursuant to the Clean Water Act.

2.4.2 Sanitary Sewage

All sanitary sewage shall be disposed of in an approved manner. In the case of in-ground disposal, approvals must be obtained from the Department of Labour in terms of the Plumbing and Drainage Act.

In large operations, or where a small town or construction camp is involved, the company may propose conventional above-ground biological treatment, possibly using a lagoon, a package plant, or an activated sludge process. In this case a permit is required in terms of the Clean Water Act as described in Section 1.4.

3. WASTE WATER TREATMENT TECHNOLOGY

3.1 General

The best practicable technology for treating non-acid mine drainage is basically simple and unsophisticated. Suspended solids removal is usually accomplished by using retention ponds for settling, sometimes accompanied by flocculation. Waste water containing high iron levels is effectively pretreated by optimum pH adjustment and aeration to ensure conversion from the ferrous to ferric form followed by solids separation, usually settling, sometimes accompanied by flocculation. Filtration is considered to be a technology that may have application when treating flows containing excessive levels of unsettleable contaminants.

3.2 Retention Ponds

Retention ponds are by far the most common form of mine waste water treatment facility, being rugged, relatively cheap to construct, and usually easily reclaimed. Retention ponds may take the form of either dugouts or impoundments and are usually operated to effect suspended solids removal be settling.

The efficiency of well designed settling ponds is limited by the nature of the sediments handled. Sand is easily settled while clays, such as bentonite or iron flocs, can be colloidal in nature and efficient removal may require the use of flocculents to coagulate the suspended matter into a settleable form.

The following guidelines apply to the design, construction, and operation of retention ponds:

(a) The suspended solids removal design efficiency shall be based on achieving the mine waste water standards in Section 4, Schedule A during a 10-year (24-hour duration) storm.

(b) The volume flow of waste water for which a retention pond is designed shall be calculated based on sound hydrological and stream flow data. The widely used Rational Formula* is usually

acceptable for estimating the surface runoff due to precipitation in a watershed area provided some substantiation of its reliability in the particular situation is provided.

*Q = CIA

where Q = Volume flow (cubic meters/second)

C = Runoff coefficient

I = Rainfall intensity (centimeters/hour)

A = Contributing area (hectares)

(c) Adequate sediment storage capacity shall be provided. This should be justified on the basis of the erosion potential of the disturbed land and the area involved.

(d) In the case of a settling pond, the settling characteristics of the suspended solids on which the design of the settling pond is based should be obtained by conducting tests on actual waste waters approximating those expected and not on artificial materials. Adequate effective surface area as well as retention time should be provided for effective settling at 10-year (24-hour duration) storm flow loadings, and provision should be made to minimize the effects of peak inlet flow conditions.

(e) A retention pond should preferably be located out of a stream bed unless the upstream watershed is to be seriously disturbed. When the impounding of a significant stream is proposed, the company must justify the location in terms of its mining plan.

(f) A retention pond shall be constructed in a location that allows ready accessibility for dredging. All ponds should be inspected if necessary preferably just before the freeze-up. This will allow maximum pond capacity for the spring freshet. Excessive sediment buildup must be avoided as this will cause a pond to become a source of sediment downstream.

(g) Retention ponds should have a provision for lowering the water level during low flow conditions to allow extra capacity to be made available for storm events and to allow dredging without sediment discharge downstream.

(h) All impoundments shall meet the requirements of the Water Resources Act.

(i) When the waste waters to be treated consistently require only the removal of suspended solids, the use of a leaky dam or rock-French-drain-type structure may be suitable. The filter principle may, in some cases, be further extended to gravel-based ponds where the water dissipates by seepage.

(j) Site preparation for retention ponds shall include clearing of all bush, trees, stumps, roots, and other material and the salvaging of available soil and/or regolith material for future reclamation.

(k) Embankments and areas disturbed during construction of retention ponds shall have vegetation established as soon as possible after construction.

4. STANDARDS FOR COAL MINE WASTE WATER

4.1 Basis for Mine Waste Water Standards

The standards in this section are guided by the recent United States Environmental Protection Agency's guidelines for the coal mining industry in the United States (41 FR 19841 dated May 13, 1976) which, in turn, are based on the "Development Document" (EPA 440/1-76/057-a dated May, 1976). The Alberta standards in Schedule A (page 17) additionally make allowance for the natural background suspended solids content of the surface water in the immediate area of the mine.

4.2 Mine Waste Water Standards

The standards in Schedule A apply to all coal mine waste waters except hydraulic mine coal transport waters. This includes all waste waters described in Sections 2.3 and 2.4. Because the volume and nature of waste water from a coal mine are generally unrelated to coal production quantities, all waste water standards are expressed in terms of concentration rather than units of production.

Schedule A refers to the analysis of any mine waste water as sampled just after discharge from a final waste water treatment facility or retention pond, or, if the waste water is untreated, just before discharge into any receiving water.

Schedule A

Water Contaminant or Parameter	Standard 24-hour average
Total Suspended Solids (Nonfiltrable Residue)	50 milligrams/litre Max. Absolute or 10 milligrams/litre Max. above the natural background concentration, whichever is the greater.
Total Iron	3.5 milligrams/litre Max. Absolute.
pH	Within the range 6.5 - 9.5

Note: Standards contained in Schedule A shall be null and void in the event of a 10-year storm being exceeded on the mine site.

The point at which the natural background concentration will be measured will be based on site-specific considerations. It will either refer to the receiving stream concentrations upstream of the point of discharge, or, if this water is already considered polluted by other activities, reference will be made to the concentration in an unaffected stream in the immediate vicinity.

4.3 Abandonment

The mine waste water standards in Section 4.2 and Schedule A will be considered to remain in force until the following relevant provisions have been complied with:

(a) the disturbed land returned to its final contour and revegetated in terms of the government approved reclamation plan;

(b) the continuing discharge of any waste waters from mines prevented if the waste water composition exceeds the limitations in Schedule A.

5. SAMPLING AND ANALYSIS

By definition, compliance with the numerical mine waste water standards for total suspended solids or total iron tabulated in Section 4, Schedule A shall be determined on the basis of a composite sample. A composite sample shall consist of not less than twelve portions of equal volume collected at equal time intervals over a 24-hour period.

The standards applying to pH are not subject to variance and shall be met at all times on the basis of a grab sample.

Analysis of all samples shall be conducted either:

(a) in the manner described in the publication "Standard Methods for the Examination of Water and Wastewater", 15th Edition (1980) published jointly by the American Public Health Association, American Water Works Association, and the Water Pollution Control Federation; or

(b) in the manner described in the "Methods Manual for Chemical Analysis of Water and Wastes" published by Alberta Environment, 1980; or

(c) by any other equivalent method, approved in writing by the Director of the Pollution Control Division, the results of which can be confirmed by the methods referred to in subsection (a) above.

6. MONITORING

Coal mines will be required to adhere to a regular waste water monitoring program. Because the operation, location, and scope of coal mines vary broadly, it is not possible to specify overall monitoring guidelines; therefore, these will be specified in individual permits and licences.

Sampling will focus on actual waste water discharge points; the frequency of monitoring will depend on the flow characteristics (i.e. typical rate and variability) and the usual concentration of the contaminants. Certain discharges will require monitoring during storm events. Monitoring will also be required if it is necessary to ascertain the natural background level of relevant chemical parameters.

Waste water monitoring will generally require the use of portable automatic composite samplers to obtain a representative 24-hour average sample. Depending on the waste water discharges, monitoring requirements will generally be reduced or eliminated after the freeze-up as specified in individual permits or licences. Usually, grab sampling only will be required during the winter months.

Typically, analyses that will be required on a routine regular basis include

Total Suspended Solids
Total Iron
pH
Turbidity

Depending on individual circumstances, certain additional information may be required, for example,

more intensive chemical water anayses,
heavy metal analyses,
bioassays on waste waters,
macrobenthic invertebrate surveys on receiving waters, and
groundwater monitoring.

Approved analytical techniques are as described in Section 5(a), (b) and (c).

7. REPORTING

The following reporting requirements shall be maintained for all coal mines:

(a) The operator shall report or confirm any awareness of the occurrence of non-compliance with any condition of a licence or any uncontrolled release of contaminant, accidental spill or discharge, as specified in Part 3 of the Clean Water (General) Regulations OC 216/73.

(b) A monthly report shall be submitted to the Director of Pollution Control within thirty days of the end of the month for which the observations were made and shall contain the following information:

(i) results of analytical waste water monitoring as specified in the relevant permit or licence;

(ii) remarks relating to precipitation, snow melt, and general weather conditions;

Note: These remarks should include specific reference to the conditions during which the sampling of waste waters was conducted, as reported in (i) above.

(iii) brief comments relating to the operation of the coal processing plant and the mine waste water control facilities if any non-routine conditions, relevant to water quality, are encountered.

(c) An annual report shall be prepared and forwarded to the Director of Pollution Control by March 31. This report shall include:

(i) remarks on any alterations or additions to the waste water treatment facilities or the coal processing plant accompanied by photographs or 35 mm slides;

(ii) a statistical summary of the waste water monitoring data for the past year;

(iii) comments relating to the sediment accumulation in retention ponds or tailings ponds and dredging activities.

APPENDIX

Effect of Principal Contaminants on Receiving Waters

(a) Total Suspended Solids

This is potentially the most serious contaminant from coal mining in Alberta. High shock loadings can be discharged into streams from disturbed areas on a mine site within a short period during heavy precipitation. Excessive levels are damaging to aquatic habitats by clogging the respiratory organs of various aquatic fauna and by blanketing the bottom thus killing eggs, young, and food organisms and destroying spawning beds. Other effects include light screening which reduces photosynthesis, and the decay of organic solids on the bottom which causes localized oxygen depletion. Suspended solids, particularly in the form of coal fines, impart an aesthetically unpleasant appearance to streams and lakes, further damaging their recreational potential. The deposition of excessive solids reduces the carrying capacities of streams and causes the siltation of lakes and reservoirs.

(b) Iron

This almost always occurs in a mildly alkaline or near neutral medium in Alberta and is largely insoluble or, after oxidation, becomes insoluble. Excessive levels of precipitated iron hydroxide or iron oxide have effects on aquatic habitats similar to those of suspended solids. Iron can exhibit an appreciable toxicity but the level of fish toxicity has been shown, both in Alberta and elsewhere, to be greatly reduced in hard water. This has been attributed to a synergistic reaction with calcium. A survey in the United States showed that 95% of the waters that support good fish fauna have total iron contents of 0.7 mg/litre or less. Iron also imparts an unpleasant taste to water supplies and causes the staining of fabrics.

(c) pH

Although this is indicative of whether water is in an acidic or alkaline state, it should not be confused with the measures of acidity or alkalinity. In the coal mining situation, waste waters with a pH of less than 6.0 are generally classed as acidic drainage, an unlikely occurrence in Alberta. High and low pH levels create intolerable conditions for aquatic fauna. A range of 5-9 has been found tolerable for most fish with a range of 6.5 - 8.5 considered representative of good fish fauna waters.

Other pollutant parameters that may be of concern at a specific mine site are: mercury, manganese, aluminum, nickel, zinc, total dissolved solids, ammonia, fluorides and strontium. Concentrations of ammonia, fluoride and strontium are not normally high enough to have deleterious effects and the cost of reducing total dissolved solids levels is not warranted. The metals are generally removed to some extent along with iron and do not generally pose a problem in the alkaline medium but may require monitoring.